ADELAIDE PHILOSOPHICAL SOCIETY.

PAPER READ ON TUESDAY EVENING, JANUARY 31, 1865, BY C. TODD, ESQ., F.R.A.S.

Subject—"The Comet."

NATIONAL MUSEUM
10 JUN 1975
OF VICTORIA

"This Society will, no doubt, expect to receive from me some information respecting the magnificent comet which has adorned our sky during the last ten days. I have therefore drawn up a few remarks, which I now beg to present, at the same time apologizing for the extremely scanty information I am able to afford. It is at such times as these that one most regrets the want of powerful telescopes and a properly-equipped National Observatory—wants which I trust will ere long be supplied. Having been for some years an active practical astronomer at Cambridge and Greenwich, accustomed to the use of first-class instruments, it will be readily understood how much I sympathize with the regret expressed by Mr. Babbage that our Observatory should still be unfurnished with suitable astronomical telescopes. At the same time, while I agree with that gentleman in regretting that we are not in a position on such occasions as these to render any valuable aid to astronomical science, I must not omit to point out to you that at the time Mr. Babbage wrote I could scarcely have been able to supply fuller information than I did in my letter published in the *Register* on Monday, the 23rd, even had I possessed more efficient instruments, except, perhaps, some particulars as to the structural appearance of the comet, which a more powerful telescope might have revealed. I may also add that having the weight of a large commercial department resting upon me, and requiring my constant supervision, I feel no little hesitation in undertaking the direction of a National Observatory, unless I can have proper assistance. What I am desirous of obtaining for our Observatory are a large equatoreal and a good transit circle, similar to those mounted at the Melbourne Observatory. These would cost in England about £1,200, to which must be added freight, cost of suitable building, mounting, &c. To make profitable use of such instruments I should require at least one properly-qualified assistant. I feel that I have at present quite enough on my hands in the active management of the Telegraph Department and the supervision of the system of meteorological observations I have as yet but only partly organized. According to the Rev. Jas. Maughan's letter, published in the *Register* of the 25th, that gentleman first saw the tail of the comet as a white luminous streak on the horizon just after sunset on the evening of Wednesday, the 11th inst. (the rev. gentleman says 12th, so he may mean Thursday). If so, he was probably the first in the world who observed it. A few persons appear to have seen it on Tuesday evening, the 17th. It was observed at the Melbourne Observatory for the first time, I believe, on the evening of Thursday, the 19th, when its position was ascertained to be—right ascension, 20h. 38m.; declination, 35° 2′. It was observed again on the following evening, when its right ascension was found to be 20h. 45m., and declination 37° 10′, showing a daily motion in right ascension of 7 minutes, or 1° 45′ in arc, eastward, and 2° 8′ in declination to the south—*i.e.*, a general S.E. course. I was unfortunate in not seeing it till late on Friday evening, the 20th, just before the comet passed behind a bank of light cloud in the south-west horizon. The next night was unfavourable for seeing the comet well, dark clouds continually passing over and hiding it from view, but between the breaks it was extremely bright; indeed, appearing all the brighter and more splendid by contrast with the surrounding dark clouds. Sunday night was very clear, and in every respect favourable for examining the structural appearance of the comet. I had only a good Dollond's telescope having an object-glass of about 2½ inches aperture. But as seen through it, the nucleus appeared as a bright nebulous star—as bright as Alpha Gruis of the second magnitude, at the extreme end or head of the comet, having no surrounding anterior coma, and less bluff than on the preceding evening. The tail was exceedingly bright, and when the sky was quite dark was estimated to be at least 14° long, and slightly curved northward towards the star Alpha Gruis, a small star of the 5-6th magnitude (1752) in Indus being just on the northern edge. Subsequent measurements have made the length of the tail 14° or 13° 40′. I have taken a series of differential observations in azimuth and altitude, between the comet and Alpha Gruis, with an excellent 6½-inch theodolite, on several evenings since I first saw it, the result of which when calculated will be sent to the Royal Astronomical Society. Although involving much more labour in their reduction, the observations will necessarily be in every respect inferior to those made with the fine equatoreals at Melbourne, Sydney, and the Cape of Good Hope. Had, however, no other observations been taken elsewhere they would have been sufficient to deduce therefrom approximate elements of the orbit, and have served to identify the comet with any previous apparition. The accompanying sketch shows the approximate apparent path of the comet between the 19th and 30th January as given by my observations. Now the question naturally put by every intelligent person is—has this comet ever been seen before? Are you able to identify it with any previously-observed comet? Well, I must at once confess that I am unable at present to answer the question satisfactorily. No orbit has yet been calculated, and I can only hazard a conjecture of little actual worth. You are no doubt aware that comets are frequently observed through so small an arc of their orbit as to render it extremely difficult to assign any definite period, or to determine the dimensions of the ellipse; in fact, the observations are generally satisfied with a parabola and occasionally an hyperbola. Where such is the case we can only identify a comet with another previously recorded by similarity of orbits, as shown by what are technically called its elements. When, for instance, a parabolic orbit is deduced from the observations, we know—1st. Its perihelion distance from the sun; 2nd. The longitude of its perihelion; 3rd. The inclination to the ecliptic; and, 4th. The longitude of the node, which four quantities serve to fix the position of the orbit in space. Now, suppose a comet to be seen which, besides presenting somewhat similar physical characteristics, is found to move in nearly the same orbit as another comet previously seen, although the observations by themselves may be insufficient to determine its period, we shall be justified in regarding it as at least very probable that it is the same comet; and perhaps, by a closer analysis of the observations, &c., we may be able to prove it to be so beyond all doubt, especially if by searching the records of the past we find notices of still earlier apparitions. It was somewhat in this way that Halley identified the comets of 1531 and 1607 with that of 1682, since called Halley's comet, and justified his predicting its return in 1758, and that its perihelion passage would occur early in 1759. With improved mathematical analysis Clairaut, assisted by Lalande and Madam Lapaute, who laboured unremittingly at the calculations for six weary months, showed that its perihelion would be reached on the 11th April, 1759, or possibly sooner, owing to the action of Jupiter and Saturn, which together delayed it about 618 days. The comet was first seen in December, 1758, and passed its perihelion on March 13, 1759. At its last apparition it was discovered on August 5, 1835, within about a degree of the place predicted. Mr. Hind has since traced successive apparitions of the comet with more or less probability as far back as the year 11 B.C. The comet of 65, which passed its perihelion on August 5, and was described as the sword-shaped sign seen over Jerusalem at the commencement of the war which ended in the destruction of the Holy City by Titus, may have been the comet of Halley. Now, it has been suggested by Mr. Babbage that the present comet is identical with the magnificent comet of 1843, his suggestion being based on the remarks of Sir John Herschel in his "Outlines of Astronomy." It will be exceedingly interesting should it prove to be so, for it will set at rest the question as to the identity of the comets of 1668 and 1689, which Clausen considered were identical with that of 1843, having a period of 21 years and 10 months; while others maintained that the comet of 1668 was identical with that of 1702, and the same as that seen in 1843, with a period of about 35 years, as assumed by MM. Laugier and Mauvais, who noticed the comets of 1528, 1492, 1457, 1106, 1001, 685, 580, 369, 335, 194, 159, and B.C. 367, as possibly the same. The observations of the comet of 1843, although it was perhaps the finest ever seen, were not sufficiently accurate and extended to admit of more than an approximate orbit being calculated. The parabolic orbit of MM. Laugier and Mauvais best satisfy the observations in the opinion of the Arago. The comet was first seen at Conception, in South America, on February 27, when its distance from the sun was estimated at 5′, or one-sixth of the sun's diameter. It was then at its perihelion. It passed nearer to the sun than any previously known comet, and between the 27th and 28th of February it traversed 292° on its orbit. The length of the tail was 60,000,000 leagues, and the diameter of the head 38,000 leagues. It was not generally seen in Europe till the 17th March, though Mr. Cooper, of Markree, and others saw it in Italy on the 12th. At Greenwich the tail only was seen, and was at first noted as a cirrus cloud. In Australia you saw it in all its glory. Mr. Cooper was the first to suggest, in a letter to Professor Schumacher, its possible identity with the comets of 1668 and 1702; but it was only a guess. He was at Nice, and reports the tail as parallel to the equator, and under the line joining Eta Leparis with Gamma Eridani on the 13th March. He failed to see the nucleus that evening, it being too low down. The elements of its orbit, according to Laugier and Mauvais, are:—Perihelion passage, February 27, 34 G.M.T.; longitude of perihelion, 278° 17′ 33″; longitude of node, 357° 52′ 4″; inclination, 36° 20′ 33″; log. perihelion distance, 7·7793757; eccentricity, 0·99943383765; motion, retrograde. We will compare these with the elements of the comet of 1668. 1668—Perihelion passage February, 28.8 G.M.T.; longitude of perihelion, 277° 2′; longitude of node, 357° 17′; inclination, 35° 58′; log. perihelion distance, 7·68000; motion, retrograde. The foregoing elements were calculated by Henderson after the comet of 1843. He had previously deduced the following orbit, which differs widely; the observations were, however, very roughly made, and the places obtained by laying its track down on a map:—Perihelion passage February 24.78 G.M.T.; longitude of perihelion, 40° 9′; longitude of node, 193° 26′;

inclination, 27° 7′; log. perihelion distance, 9·39990; motion, direct. The former satisfy the observation better than the latter or first elements. The comet of 1668 bears a strong resemblance to the comet of 1843. It was seen only in southern countries, its tail, being seen at Bologna by Cassini, extended from Cetus to Eridanus, and subsequently to Lepus; but its head was lost in the rays of the sun. It was also seen at Tonquin by a French mission to Cochin-China; but the accounts do not agree very closely with Cassini's. As I mentioned before, Clausen considered the comets of 1668 and 1689 identical, and the same as 1843. The elements of the 1689 comet are as follows:—Perihelion passage, 1689, December 2·14, G.M.T.; longitude of perihelion, 271° 16′: longitude of node, 344° 18′; inclination, 30° 25′; log. perihelion distance, 8·01284; motion, retrograde. This comet was not seen in Europe, and the observations which have been handed down, being mainly extracts from a Dutch ship's log, are extremely rough, so that no great reliance can be placed on the foregoing elements. The tail only was visible at Pekin between the 11th and 15th December. The nucleus is described as having a daily motion of about 3°, and the tail 68° long in the form of a sabre. If the comet of 1689 is the same as 1668 and that of 1843, then it was just barely possible that the comet now visible might be a reappearition of that comet; but since writing the foregoing, I have read Mr. Ellery's letter to the *Argus*, giving approximate elements of the orbit of the present comet deduced from the Melbourne observations of January 20, 22, and 24, which settles the question. They can of course be considered as only a rough approximation, but are quite sufficient to show that the comet is not identical with that of 1843."

The following is the letter referred to:—

"To the Editor of the *Argus*.

"Sir—We have been able to observe the comet on most evenings since its first appearance here on the 19th instant.

"The approximate position I then gave was—Right ascension, 20h. 38m.; declination, 35° 2′ S.

"Although it has decreased considerably in brilliancy, it will have been observed that it has presented a more imposing appearance, from the great increase in the length of its tail, which at first only measured 7°, but now measures nearly 14°. The Assistant Astronomer has computed its orbit from the three following positions, viz.:—

January.				Right ascension			Declination.		
dys.	hrs.	min.	sec.	hrs.	min.	sec.	deg.	min.	sec.
20	8	18	6	20	45	41·8	37	7	3
22	8	27	58	21	0	3·7	49	27	57
24	8	50	1	21	13	48·9	43	10	44

"He finds that the comet is at present too near its perihelion, and the intervals between the above dates are not sufficiently large to admit of the orbit being accurately computed; they have been used, however, to approximate to it, whence it appears that its distance from us is only 3,530,000 miles, or about one-thirtieth of that of the sun, which is the probable reason of its improving appearance. The longitude of the node is 292° 6′, and that of the perihelion, 123° 11′; inclination, 5° 6′; perihelion distance, 0·9473; and perihelion passage January 22; motion, direct.

"A comet with the above elements is not to be found in either of the catalogues we possess, so that it is probable it has not previously appeared to us. It further seems likely that it will be visible for some time, as its motion is nearly in the same direction with that of the earth.

"Although the comet was seen at this Observatory for the first time on the 19th instant, I have received communications from several gentlemen, showing that it was seen on the 17th and 18th instant at Deniliquin, Colac, Tarnagulla, &c. It was not seen by the astronomers at Adelaide or Sydney till after the 19th instant. Some of our later observations having involved comparisons with stars whose places are not well determined—which, from the paucity of Observatories in this hemisphere, is too often the case with stars in the southern heavens—it will be some months before they can be observed with our fixed instruments for that purpose. A considerable time must therefore elapse before the orbit can be computed with all desirable accuracy.

"I remain, yours faithfully,

"Robt. L. J. Ellery,

"Government Astronomer."

"Observatory, January 27."

W. K. Thomas, Printer, Register and Observer Steam Printing Offices, Grenfell Street, Adelaide.

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